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PREFACE

In 1990 the Environment White Paper, '*This Common Inheritance*'[1], set out our firm commitment to wise stewardship of the planet and its natural resources. We reaffirmed that commitment at the Earth Summit in Rio de Janeiro last month.

There is no aspect of natural resources more important than water. The Earth Summit showed vividly how fortunate we are in this country to have copious supplies of high quality water piped to virtually every home. Yet even here, four successive dry years in the South-East of England have brought home to us how dependent we are on natural cycles, and on working with environmental forces. That makes it important that as a community – Government, the public bodies, the water industry, equipment manufacturers, and water users – we should show a sense of responsibility towards water consumption.

We now have an efficient water industry, which is using the freedom of the private sector to carry through a massive investment programme. Much of that is to clean up discharges from sewage treatment works or to make further improvements in the quality of drinking water. Some of it is to augment supplies of water to meet the steadily growing demand. If current patterns and practices of consumption are maintained, the water industry will be obliged to bring forward very soon further large-scale schemes, such as new reservoirs or transfers between river basins. These are inevitably costly and can have serious environmental impacts. The costs fall both on consumers and society more widely. It should not be assumed as a matter of course that the answer to water shortage is further massive increases in the capacity of supply.

This is a time to take stock of our attitude to water, to see whether we are using it in the wisest way.

This is a complex issue and many bodies and people have a part to play. This consultation paper considers what Parliament, the Government, the Office of Water Services, the National Rivers Authority, water companies and the individual citizen could do to bring about the more efficient use of water. By publishing it, I hope we shall stimulate a wide debate about what our objectives should be, and how we should now seek to achieve them.

Michael Howard

THE RT HON MICHAEL HOWARD QC MP,
SECRETARY OF STATE FOR THE ENVIRONMENT

SUSTAINABLE USE OF WATER

1.1 Water is essential for human, animal and plant life. A sufficient supply of clean safe water is essential for public health. Water is essential for agricultural production, for most energy production, and for many industrial processes. The volume, precise composition, flow and other characteristics of water in any particular location are vitally important in shaping the ecosystem to be found there.

1.2 A plentiful supply of water is fundamental to the quality of human life in the modern world. As incomes and wealth rise, so does water consumption – for desirable things such as showers, washing machines, dishwashers, car-washing, gardens and lawns, golf courses, and all the other things which add to the quality of modern life. Today, too, we rightly give much greater importance than in earlier years to conservation and enhancement of the environment, and ensuring that flora and fauna have the water they need.

1.3 In England and Wales in general the volume and pattern of rainfall ensure that there are abundant amounts of raw material for water supply. Overall, water put into public supply represents only 4.4% of rainfall. This masks the fact however that average rainfall in the populous, prosperous South East and East Anglia is, at 24 inches (610 mm) a year, relatively low, while that in the Welsh Region of the National Rivers Authority (NRA) is over twice the Anglian average. From year to year, too, regional rainfall can vary markedly, by as much as a third.

1.4 In these areas as the propensity to consume water rises with rising living standards, local or more widespread shortages can be expected to become more common unless measures are taken to increase supply or restrain unnecessary demand.For many years supply has increasingly been assured by transferring water between catchments, whether on a grand scale from the Lake District to the cities of the North-West, or from Wales to Birmingham, or on a smaller scale. Since the drought of 1976 much has been done, in a largely unadvertised way, to link sources and reinforce supply systems (for example, by providing long-distance trunk mains), with the object of avoiding or minimising restrictions to supply in periods of drought. Despite the prolonged drought in the South-East over the last four years, restrictions have so far been comparatively limited.

1.5 Nor does it follow that because the raw material is plentiful, supply can be cheap – though, as a matter of fact, an average of about 45p per household per day for water supply and sewerage services represents remarkably good value for money. The water must be collected, stored, treated and delivered before it can be used. This requires extensive and expensive capital equipment and very substantial operating costs. The costs have to be met by consumers. They are also being asked to pay for a vast capital programme already committed (£28 billion in the current decade) which is aimed largely at improving the existing water supply system including drinking water quality, and at reducing the impact of sewage discharges on the environment. Money spent on one thing cannot be used for another and, insofar as water bills are rising more quickly than the rate of inflation, a necessary shift is taking place in the use of domestic budgets. A large additional programme of capital expenditure to increase the amounts of water available for supply would add further to the burden on consumers.

1.6 Major works to increase supply also have environmental costs. Reservoirs require the flooding of land on a large scale, with consequent changes to familiar landscapes and losses of flora and fauna - though it is also possible in the process to create new wetlands to replace those lost elsewhere and to create new opportunities for leisure and enjoyment of water and countryside. Large-scale water movement can also have impacts on ecosystems where the water concerned has different biochemical qualities.

1.7 We should not take it for granted therefore that the only answer to existing or predicted water shortage should be major increases in supply, especially when under the present charging system the extra costs of such supply would be spread across the bills of most consumers according to property values and not related to the extra volume that they are consuming. The better course may be action to cut waste or reduce demand. But that too may increase costs or reduce benefit for the consumer. These disbenefits vary from case to case and it is a question of comparing the alternatives. It may, for example, be virtually costless to change the consumption requirements for new WC cisterns or dishwashers – and in some cases there may be resulting energy savings as well. In current circumstances, action to reduce leakage and selective metering will often be economic. But in some cases, even when proper account is taken of the environmental costs, it may on balance be preferable to build a new reservoir rather than to invest larger sums in further reducing leakage or in blanket installation of meters to reduce demand.

1.8 The purpose of this consultation paper is to consider the scope for reducing demand for water use as an alternative to major works to increase supply. It describes the main ways in which we use water at present (chapter 3, pages 7-9); and discusses how our water resources are managed, and the means that have been proposed for augmenting them (chapter 4, pages 9-12). It then turns to measures which might be taken, within the existing broad pattern of arrangements, to cut waste and reduce demand (chapters 5 - 9, pages 12, 15, 18, 20, 21). Finally, it reviews more radical ways of reducing demand, chiefly by way of different types of economic instrument (chapters 10 and 11, pages 24-26 and 26-29). The specific proposals put forward for consultation are summarised in chapter 12, pages 29-32.

1.9 From case to case, action may fall to one among a wide variety of bodies and individuals – from Government and Parliament where a change in statute or regulation would be needed, to NRA, the Director General of Water Services (OFWAT) or the water companies, to individual consumers. These various roles are more fully described in chapter 2, pages 5-6. The character and timescale of possible action also varies: much can be done voluntarily by consumers without any significant disbenefit to themselves, encouraged by information from the Government, the NRA, OFWAT, and the water companies and perhaps within a changed framework of price incentives. Alternatively or in addition legal changes, for example to Building Regulations or Water Byelaws, may add to the force of measures. For convenience the paper considers the possibilities topic by topic, rather than by either type of measure or identity of body or person by whom action would be needed.

1.10 The Government's purpose is to initiate a wide and constructive debate on the options. This consultation paper is a first step. Comments and views of interested bodies and individuals should be sent by 31 October to **Mr C Kearney, DOE Water Services Division, Room A444, Romney House, 43 Marsham Street, London SW1P 3PY (telephone 071-276 8946; fax 071-276 8534).** Those in Wales are asked to send an additional copy to **Mr P Bishop, Environment Division, Welsh Office, Cathays Park, Cardiff CF1 3NQ.** General views and alternative proposals are invited, as well as comments on the specific proposals in this paper.

1.11 It is the Departments' practice to make response to consultation papers available to Parliament and for public inspection in their libraries. Unless you specifically indicate that your response is to be kept confidential, the Departments will assume that you have no objection to its being made publicly available. Confidential responses will be counted in any public figures on the number of responses to the consultation.

WHOSE RESPONSIBILITY?

2.1 The Government, NRA, OFWAT, water companies and local authorities all have a part to play in bringing about the more efficient use of water. So do other industries and the individual citizen. This chapter describes where relevant responsibilities are located at present. It also poses a question. Is the present formal structure adequate, or does achieving a sustainable approach to our water resources require some modifications of present responsibilities?

The role of DOE and Welsh Office

2.2 The responsibilities of DOE and Welsh Office in relation to water use cover legislation and general policy. They have specific responsibility for Water Byelaws, any Regulations made to replace them, and the Building Regulations. The Secretaries of State also consider appeals against decisions of NRA on abstraction licences. DOE will take the lead in considering the responses to this consultation paper, and identifying which of the proposals summarised in chapter 12, pages 29-32, the Government ought to take forward.

The role of NRA and water companies

2.3 The National Rivers Authority (NRA) has a general duty under Section 19 of the Water Resources Act 1991 to conserve, redistribute or otherwise augment water resources and to secure their proper use. It is also required by Section 16 of the 1991 Act to exercise its powers in such a way as to further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographical features of special interest. It mainly fulfils its water resources functions by exercising control over abstractions of water from surface or underground sources. The legislation under which this licensing system operates is described in Appendix 1, pages 32-33.

2.4 In every area of England and Wales there is a water undertaker appointed under Section 6 of the Water Industry Act 1991, with a duty under Section 37 of that Act to develop and maintain an efficient and economical system of water supply within its area, and to ensure that arrangements have been made for providing supplies of water to premises in that area and for making such supplies available to persons who demand them. Under Section 38(1) the Secretary of State has power, following an application from the Director General of Water Services, to supplement this basic duty by making regulations establishing overall standards of performance, but there has not as yet been any proposal that this should be done.

2.5 NRA is required by Section 15 of the Water Resources Act 1991 to have particular regard to the statutory duties of water undertakers. Section 19(2) of that Act says that NRA's general duty in relation to water resources does not relieve any water undertaker of the obligation to develop water resources in order to fulfil its own statutory duty (para 2.4, page 5). The ability of a water undertaker to develop water resources is of course subject to the constraints that it must first obtain any necessary abstraction licence and any necessary planning permission.

2.6 When a water company submits an application for a new licence, or an increase in the authorised amount under an existing licence, NRA has said that in appropriate cases it will expect to receive with the application an assessment of the potential contributions from leakage control and metering in reducing demand for water

2.7 NRA has a responsibility to promote water savings among those who abstract water for purposes other than public supply. In terms of the volume of water involved, that means primarily industry. Agricultural abstractions are also significant because many of them are in sensitive locations and little or no water is returned after use

2.8 The primary statutory duties of water companies relate to the supply of water. They are private sector companies answerable to their shareholders, and the turnover and profits of the regulated businesses come from supplying water.

2.9 In the short run water companies are active in promoting water savings, not only in drought situations, but more generally. They have made substantial reductions in leakage from their own systems and provide their customers with some information about methods of saving water. In the longer term however it is desirable that they should receive more effective financial signals, which properly reflect the status of water as a scarce resource and the environmental costs that would be attached to exploiting new sources of water. Chapter 10, pages 24-26 discusses how that could be achieved.

Alternatively, if price mechanisms are not brought to bear, it might be desirable that water companies should be subject to precise and effective regulatory requirements about water savings.

The role of the economic regulator

2.10 The Director General of Water Services is required by Section 2 of the Water Industry Act 1991 to use his powers in a manner which he considers best calculated to promote economy and efficiency on the part of water and sewerage undertakers. He has a crucial role in relation to the operation of charging systems and thus an important influence on the extension of metering (chapter 11, pages 26-29). He also has a role controlling leakage (chapter 5, pages 12-14). He is also subject to a general duty (under Section 3 of the Water Industry Act 1991, and so far as is consistent with his other duties) to exercise any power he has in relation to any proposals he is formulating or considering in such a way as to further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographical features of special interest. However, in contrast to the statutory functions of the gas and electricity regulators in relation to energy conservation, the Director General of Water Services does not at present have any specific functions in relation to the efficiency with which consumers use water.

The role of industry

2.11 A major contribution towards reducing the demand for water can be made by private firms designing, manufacturing and marketing either more efficient appliances or devices to save water or recycle it. Pressure for people to be more efficient in their use of water generates a business opportunity. A whole new industry could emerge based on water-efficiency products. And the fastest progress towards saving water could well be achieved through the spread of innovations created and promoted by technologically oriented UK firms.

2.12 The Department of Trade and Industry is committed to helping firms, especially small and medium sized ones, to understand such new opportunities for environmental technology and carry out the fundamental work necessary to bring innovative products to market. It can help put firms in contact with others in the UK and overseas willing to collaborate on market development and on research into new products and processes. It also operates grant schemes designed to encourage environmental innovations, improve environmental standards, help users or suppliers of environmental technology to become more competitive, and promote the widespread adoption of technologies and best practice techniques that have potential environmental benefits.

The individual citizen's responsibility

2.13 Although this consultation paper is inevitably devoted primarily to actions that are being or could be taken by Government or other organisations, the ordinary citizen also has responsibilities in ensuring that water is used wisely. There is already a legal responsibility, in that a customer is committing an offence under the Water Byelaws if neglect of the water supply installation causes water to be wasted (or contaminated). But over and above that there are a number of ways in which decisions by the ordinary citizen are crucial:

i. considerable amounts of water are lost from leaks in the customers' pipes. It is the customer's responsibility to put them right. More widespread metering will facilitate the detection of such leaks;

ii. any customer of a water company can choose to have a meter installed and pay for water by volume, provided he or she meets the cost of installation and (in most company areas) the cost of the meter;

iii. it is the householder who decides whether to replace existing plumbing or fittings with the more efficient devices that are now becoming available, and to use water economy as a criterion for choosing between different models of water using appliances.

The scope for further action

2.14 At present it is only NRA which has among its functions a specific reference to water conservation, in the form of a requirement to conserve water resources and secure their proper use (para 2.3, page 5). Almost all water users however obtain their water, not under an NRA licence, but from a water company licensed by the Director General.

2.15 Although the present legislation gives water companies a substantial role in preventing waste of water, there is a strong case for placing a positive duty on them to promote the efficient use of water. This would take the form of an amendment to primary legislation, which could also extend to any extensions or modifications in the statutory powers of water companies that may be necessary to enable them to fulfil the duty satisfactorily.

2.16 There is a strong case for making a parallel extension in the Director General's duties, so that he would be required to promote, not only economy and efficiency on the part of water undertakers, but also economy and efficiency in the use of water. A further option would be to give him powers broadly paralleling those now possessed by the gas and electricity regulators.

2.17 Both NRA and OFWAT already have a close interest in leakage control measures and in the extension of household metering. They need to discuss and agree the criteria that should be applied in assessing the economic case for these measures. It is important that these criteria should take into account environmental benefits as well as financial savings

2.18 Changes in formal responsibilities may not be very effective unless there are also supporting changes in the structure of incentives. The forms that such changes might take are discussed in chapter 10, pages 24-26.

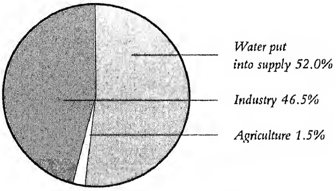
2.19 DOE will consider what can be done to maximise the contribution of the manufacturing and installation industries to promoting water savings (para 2.11, page 6), for example by making use of award schemes for innovation.

2.20 Ordinary citizens have a central responsibility (para 2.13, page 6). In areas affected by drought, water companies report that customers have responded well to appeals to them to use less water and stop leaks. For many people the motivation is already there to use water wisely. But in order for ordinary citizens to make the maximum contribution to greater efficiency, not only in droughts but all year round, they need to have authoritative and comprehensive guidance readily available about preventing waste, about what are the most efficient ways of using water, and the relative costs. DOE and Welsh Office will consider, in consultation with the water industry, how such guidance can best be provided.

3.HOW DO WE USE WATER?

3.1 In order to design a sensible programme to improve our use of water, we need to know with sufficient accuracy how much water we use, and what we use it for. Just over half the water abstracted from surface and underground sources in England and Wales is taken and distributed by water companies. Most of the remainder is abstracted by industrial users (mainly for cooling), although a small proportion of the national total is taken for agricultural irrigation.

Estimated abstractions 1990 in England and Wales



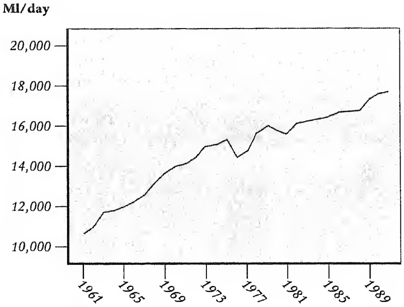
Source: Digest of Environmental Protection and Water Statistics No.14 1991[2]

Direct abstractions

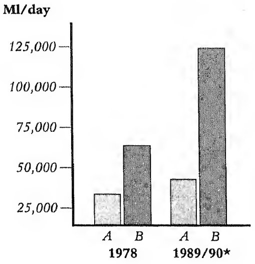
3.2 Abstractions by electricity generating companies for cooling account for over 75% of industrial abstractions. Large proportions of these and other industrial abstractions are generally returned to rivers and, unless that is done below the tidal limit, may subsequently be abstracted again for further use. Much of the water abstracted for agricultural purposes does not return to rivers. Agricultural demand, though small overall, is more significant than the amount of water involved would imply because it tends to arise at the times and in the places where water resources are least available; but it is an essential element in producing good quality produce.

3.3 The water supply industry accounts for the greater part of water abstracted and, together with its customers is the main focus for this consultation paper. After the second world war the steadily rising trend in the amounts of water supplied by public water suppliers partly reflected the rapid extension of piped water in rural areas and an increase in the provision of bathrooms in new and existing housing. Since 1961 the rise has been roughly 1% a year, as is shown in the graph. This is as a result of substantial increases in the demand for water from each household.

Water supplied by the water industry



3.4 There is less information available about trends in the total amounts of water abstracted for all use over the same period because it was only under the Water Resources Act 1963 that a system of licensing was introduced for direct abstractions. The available statistics, presented in the bar chart below, indicate the rise since 1978 both in the amounts of water licensed for abstraction and in the amounts actually abstracted:



A Amount abstracted
B Amount licensed

**Data incomplete*

Source: 1978, Water Data 1978, DOE Water Data Unit[3]. 1989/90, NRA Facts 1990[4]

3.5 Of the water actually used in households, commerce and service industries, about 95% is returned to sewers and after treatment is discharged to inland rivers and water courses. A small proportion of that is lost through leakage from sewers, and most of the remainder is discharged to the sea or to rivers below the tidal limits or disposed of as part of sewage sludge. Some of the water discharged to inland rivers is abstracted further downstream, so permitting a degree of reuse. This is at present concentrated in the Thames region, where current total demand from water companies exceeds resources, and a high degree of reuse is therefore essential in order to meet demand.

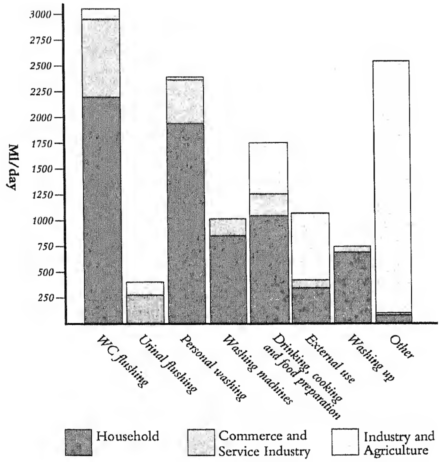
Water supplied by water companies

3.6 Of the water put into supply by water companies about a quarter is unaccounted for. Some of this is used for flushing water mains and sewers or fire-fighting. But a considerable amount is lost through leaks from water mains and customers' pipes. Chapter 5 considers what scope there is for reducing that leakage.

3.7 There is little current statistical information about the respective volumes of water supplied by water companies to households, commerce and service industries, agriculture and industry. An estimate of these volumes is assessed in Appendix 2.

3.8 Similarly, there are few current data about typical uses of water. The readily available information is analysed in Appendix 2. The chart below, based on data and assumptions in Appendix 2, shows a very broad indication of the average amounts of water likely to be used in England and Wales for different purposes within each sector.

ESTIMATED TOTAL USE OF WATER
13000 Ml/day



Scope for further action

3.9 The bar chart gives a broad indication of the volumes of water used for different purposes at present, and this is a useful guide to the relative priority of measures to save water

3.10 This chapter has shown that we do not at the moment have satisfactory statistics either for the amounts of water abstracted or about the different purposes for which it is used. As well as current statistics, we also need to establish time series, although that may have to be done gradually. DOE and Welsh Office will discuss with NRA, OFWAT and the water industry how statistics on water use can be improved.

ARE WE SHORT OF WATER?

4.1 As part of its water resources responsibilities (para 2.3, page 5), NRA has assessed the adequacy of resources to meet future demands, and published the conclusions in March in its discussion document, '*Water Resources Development Strategy*'[5]

The present position

4.2 Large parts of England are suffering from the consequences of nearly four years of unusually dry weather. Most reservoirs are at satisfactory levels. But groundwater levels in the South-East are at an all time low, and recent rain will not have any significant effect on them. In large areas dependent on groundwater there are bans on the use of hosepipes by householders, and in many of these areas there are also orders in operation banning specified non-essential uses of water. For this summer the present restrictions will have to be retained, and perhaps even extended. The priority in the short term is to maintain water supplies this summer, and deal with the depleted groundwater levels in the South-East. We also need to look at longer-term trends in supply and demand. Are present trends likely to be sustainable, in the sense that they can continue indefinitely, and yet not cause unacceptable damage to the environment?

4.3 The statutory duty on water companies to provide domestic customers with a sufficient supply of water has never been interpreted as an obligation to provide unrestricted supplies of water to all customers at all times. OFWAT has defined the following reference level for water availability:

hosepipe ban	*not more than once in 10 years*
major publicity campaign for voluntary reductions in use	*not more than once in 20 years*
rota cuts or standpipes	*or not more than once in 100 years.*

Making forecasts

4.4 The primary use for this reference level is in assessing proposals put forward by water companies for new capital investment. The figures are of course intended to be long-term averages. In practice it is difficult to assess whether the reference level is being achieved. The assessment becomes more problematic when, as now, we have reason to be concerned about the possibility of long-term changes in the climate. The assessment turns on a comparison between forecast demand and forecast supply.

4.5 The water industry has inherited a variety of techniques for assessing reliable yields of water resources schemes and NRA is currently undertaking a study aimed at deriving a common approach for surface water assessment. Groundwater yield assessment is another area of concern on which NRA plans to carry out further research and development.

4.6 NRA's assessment also assumed no significant change in the overall level of existing resources due to climate change. The recent Earth Summit in Rio de Janeiro demonstrated the seriousness with which climatic change is now taken: 153 countries signed the Climate Convention, under which they will each have to consider a national programme aimed at stabilising emissions of greenhouse gases. Specific predictions of climatic change for the UK cannot yet be made with current climate models. But among the likely scenarios investigated by DOE's Climate Change Impacts Review Group[6] was the possibility of hotter summers with increased evaporation, longer growing seasons and an increased risk of extreme warm years. All of these would place extra stress on water resources.

4.7 Making forecasts of future demands for water is also problematic. The previous rule of thumb has been that demand on the water supply industry increases at about 1% a year. NRA's Water Resources Development Strategy[5] has had to utilise individual water companies' forecasts of future demand, and it is not clear that those were on a consistent basis.

4.8 Increased use of water also has significant implications for our energy requirements. For example, some 20-25% of domestic energy consumed is used to heat water in the kitchen and bathroom. In addition, a large part of the water industry's operating expenditure goes on pumping and treating water, and is broadly proportional to the amounts of water involved. The construction of large new water resources schemes to meet increased demand for water would in itself consume large quantities of energy and other resources. The Government is already hoping to persuade the boards of all water companies to make energy efficiency one of their main management priorities as part of the `making a corporate commitment' campaign.

NRA's conclusions

4.9 The conclusion put forward in NRA's discussion document is that, at regional level, available water resources are adequate to meet existing needs. On the assumption that individual schemes prove to be environmentally acceptable, there are also sufficient technical options available to meet expected demands for water over the next 20 to 30 years. However NRA expressed concern about the situation in the South and South-East of England because:

i. these areas receive the lowest rainfall;
ii. they are expected to show the highest rate of increase in demand over the next 20-30 years;
iii. most of the available water resources are already being utilised;
iv. they contain most of the 40 locations which NRA has identified as having unacceptably low flows due to the effect of low rainfall on groundwater and excessive abstractions.

4.10 In the short run local water resources schemes could meet rising demand even in the South and South-East. In order to repair past ecological damage, NRA is also giving attention to finding solutions to the 40 low-flow situations. But NRA also concluded that urgent consideration should be given to major transfers of water between river basins to satisfy the future demands of Southern England.

4.11 It is often suggested that water shortages could be eliminated by constructing a national water grid, a network of large long-distance pipelines covering most of the country but particularly used to convey water from the North to the South-East. NRA has made a preliminary appraisal of this concept, but concluded that it would cost several billion pounds. The cost of the energy needed to pump the water would also be considerable, the equivalent of 30-100% of the annualised construction costs. This means that a national water grid cannot be regarded as a viable approach in comparison with other options.

4.12 However there are considerable possibilities for other forms of long-distance transfer, utilising rivers or possibly canals. NRA is studying these possibilities, and by next year aims to be in a position to refine the water resources development strategy for England and Wales.

4.13 Another approach often advocated is to obtain drinking water by desalinating sea water. Desalination and the shipment of water in tankers have also generally been considered too expensive to be viable. But technology is advancing and NRA is reviewing the case for these less conventional options in the light of the responses to their discussion document.

Facing the costs

4.14 Whatever form they take, schemes to augment or redistribute water resources are likely to involve substantial costs. NRA and DOE have been considering the legislative and financial framework for implementing a strategy. Regardless of whether schemes are funded by water companies or by NRA's regional water resources accounts, the financial costs would be met to a large extent by the water industry's customers. The potential size of these costs, and the implications for the price of water, are a significant consideration, given the scale of other requirements for investment by water companies, and the projection that water company prices will in any case have increased by more than a quarter in real terms in the period 1990-1995.

4.15 New water resources schemes could also involve heavy environmental costs. Differences in water chemistry (especially in acidity) mean that transfers of water between different river basins, especially transfers several hundred miles from the North or West to the South-East, could have a harmful impact on present ecology. New reservoirs on the other hand can bring about dramatic changes in the present landscape and habitats; and may create powerful pressures for the construction of new leisure facilities. Planning applications by water companies for new reservoirs will need to be carefully examined on the basis of an environmental assessment, and in all probability a public inquiry. Damming rivers and capturing high flows can lead to environmental damage by upsetting natural flood cycles and causing the drying out of important wetland areas such as marshes, water meadows and mudflats. There is widespread concern among environmental groups and the public that damage of this kind has already occurred, and could occur on an increased scale in the future.

4.16 On the other hand, there may be opportunities to design new reservoir schemes in such a way as to create new wetlands. There may also be some opportunities to increase the efficiency with which we store water, without causing harmful effects on the environment, by reviewing the operation of reservoirs. Reservoirs formed by damming a river are normally subject to a requirement to discharge water ('compensation water') to maintain the river flow downstream. Some of the compensation water requirements still in force were determined more by the needs of long-disused water-mills than by the requirements of the aquatic environment. While still ensuring that adequate water is discharged to conserve the environment, it may be possible to allow reservoirs to be filled more reliably, even when the winter rainfall is less than average.

The implications for locating new developments

4.17 The Government's view has been that local planning authorities should take into account the likely future availability of water (and sewerage) services when preparing their development plans. However, as any owner of premises has a statutory right to obtain a supply of water from any water undertaker (provided he or she agrees to meet any deficit on the local infrastructure, such as water mains require to serve the premises), and as NRA exercises control over abstractions through licensing, the availability of those services is unlikely in most cases to be a material consideration in deciding whether individual planning permissions should be granted.

4.18 The main need therefore is to address water services issues in strategic planning, and in particular to take full account of water resources implications when deciding on the location of large-scale new development. The Government is to prepare regional planning policy guidance for each region (guidance for East Anglia has already been issued). This will provide for the distribution of new house-building land between counties and between districts in metropolitan areas. County council structure plans then provide for a further distribution between districts in non-metropolitan areas. National planning policy guidance may also influence the location of development, for example by limiting the type of development which is appropriate in green belt areas. NRA is consulted by the Government in the preparation of planning policy guidance. Planning authorities are obliged to consult them about the preparation of development plans. NRA may therefore seek to encourage the location of new development to areas where infrastructure is adequate to cope with additional demands on water supplies.

The scope for further action

4.19 NRA is continuing with its task of elaborating and refining a water resources development strategy for England and Wales, and in parallel with that seeking early solutions to the 40 identified situations of current low flows. NRA is also attempting to improve and standardise techniques for assessing reliable yields.

4.20 There is considerable scope for improving forecasts of the demand for water. The discussions DOE and Welsh Office are going to initiate with NRA, OFWAT and the water industry with the aim of obtaining improved statistics of water use, as mentioned in para 3.10, page 9, will therefore also cover improvements in techniques for demand forecasting.

4.21 In preparing regional planning policy guidance for each region the Government will take full account of the water resources implications.

REDUCING LEAKAGE

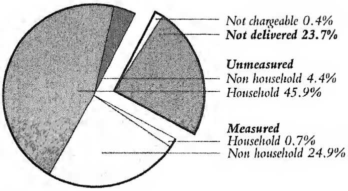
5.1 Almost a quarter of the water put into supply by water companies never reaches the customer. Major reductions in that proportion, if they could be achieved at economic cost, would considerably reduce the amounts of water companies need to abstract and enable the development of new resources to be at least deferred.

Leakage from water mains

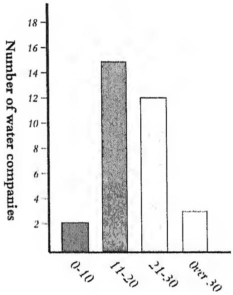
5.2 The average loss in distribution in England and Wales, using traditional methods of calculation, is estimated to be 20-25%, and the figures for individual companies range from 15% to 38%. These figures represent 'unaccounted for water', and include water drawn off from the mains for purposes like fire-fighting, flushing water mains or sewers, or street-cleaning. But there are also large losses through leakage from mains and service reservoirs. A substantial proportion of the losses are from customers' own pipes. Accurate statistics have been difficult to obtain because only a small proportion of customers have hitherto been metered.

5.3 OFWAT has made the size of losses in the distribution system a significant factor in measuring efficiency in the water industry. The traditional output measure for a water undertaker has been 'water supplied' (the amount of water put into the distribution system from the treatment works). This has now been replaced as the key denominator for comparative performance by 'water delivered' (the measured or estimated amount of water delivered by the company to customers at the highway boundary). In other words OFWAT will now expect a company to exercise control over losses from the distribution system, and its success in controlling such losses will be directly reflected in overall assessments of its efficiency. The pie chart on page 12 summarises recent data supplied by companies to OFWAT, and show that as a national average 23.7% of water put into supply was not delivered to customers.

Average water not delivered



5.4 The Director General has said that he will publish annually for each company figures for water delivered and water lost in the distribution system. This could become one of the set of Level of Service Indicators under condition J of the Licence, which are published annually for the previous financial year. The bar chart shows the range of variation between water companies in the percentage of water not delivered.



Percentage of input not delivered
(data from three companies not available)

5.5 It is inevitable that some leakage will take place from any water supply system. The variation between individual companies partly reflects differences in the condition of pipes and in ground conditions. It is possible for companies, through leakage control programmes often using sophisticated technology, to achieve significant reductions in leakage. One company calculated that a reduction of one percentage point in leakage saved it potential investment costs of £60 million. At the same time, complete renovation of water distribution networks will be a huge and expensive task. Beyond a certain point efforts to achieve further reductions in leakage may meet with diminishing returns. One water company which is spending £100 million a year on its water distribution network and claims to have reduced leakage substantially has calculated that a further reduction from 25% to 12.5% would cost at least four times as much. Water companies will have to decide what their long-term targets should be for leakage reduction.

5.6 The £28 billion investment programme for the period 1990-2000 drawn up at the time of privatisation includes a substantial element (£8 billion) for renewal of water distribution networks, as part of the long-term maintenance of the industry's assets. This will bring considerable benefits in terms of reducing leakage. The asset management plan (AMP) drawn up by each company contained a target. The programme will be reviewed as part of the task of producing strategic business plans as inputs to the Periodic Review of K, which will affect price limits from 1995 onwards. Decisions will need to be taken, company by company, about the size and the objectives of the revised programme.

5.7 At present the water industry works to a code of practice on leakage published jointly by DOE and the National Water Council in 1980[7]. The Water Services Association and the Water Companies Association have established a Joint Leakage Control Steering Group to produce a series of technical reports for incorporation in a new Code of Practice. The topics being investigated by project groups include leakage performance measures, investment analysis methodology, new technology, and training; and they are drawing on the latest expertise and knowledge both in the UK and elsewhere in Europe. The Steering Group is scheduled to publish the new Code of Practice during 1993. A primary objective is to revise the criteria used in judging the cost-effectiveness of leakage control measures.

Leakage on the customer's side

5.8 A substantial but unknown proportion of the leakage from water supply systems occurs in the part of the service pipe to individual properties for which the customer is responsible. The installation of external meters for domestic customers can lead to substantial reductions in this form of leakage, as well as in leakage from the company's part of the service pipe. The general introduction of domestic meters in an area also makes it easier to calculate precisely the losses from that particular distribution system, and thus helps the water company to find and repair leaks in its own pipes.

5.9 A tap or water fitting left dripping can waste several thousand gallons of water a year. Where water is charged by meter, the customer has an incentive to detect and minimise leakage from his or her own plumbing. The effect of slow leaks however may not always be readily apparent.

5.10 It is the customer's responsibility under the Water Byelaws to ensure that water is not being wasted. The company has powers under the Byelaws to inspect plumbing and to take enforcement action if the customer does not remedy defects within a reasonable period. In the past some water undertakers offered customers a free service for rewashering taps with the aim of minimising waste at that point and also so that advice could be given on any byelaw irregularities. This practice has,however, now generally been discontinued.

The scope for further action

5.11 Water companies are already showing that it is practicable and cost-effective to reduce substantially the leakage from their systems. The output measure and possible level of service indicator which the Director General has now defined, and the importance NRA is placing on this aspect of water company operations, will maintain the pressure on companies to reduce leaks (para 5.4, page 13).

5.12 As well as cost savings for the company, it is important that calculations of the economic case for further leakage control measures (including any linked to the new Code of Practice mentioned in para 5.7, page 13) should take into account the environmental benefits from any consequent reduction in the abstraction of water. DOE will be initiating discussions with OFWAT, NRA and the water industry in order to see whether general agreement can be reached on a methodology for that purpose. Views are invited on whether water companies should be given mandatory targets for reducing leakage, derived by using the agreed methodology. That would probably require legislation.

5.13 In the longer run an incentive charging scheme for abstractions of water, on the lines discussed in chapter 10, would give companies direct encouragement to undertake additional leakage control measures in order to reduce the amount they have to pay in abstraction charges. There might then be less need to set companies mandatory targets for reducing leakage.

5.14 In recent years water companies have paid little attention to wastage of water through leaks from internal plumbing. A more active stance might take the form either of using the sanctions available to every company under the Water Byelaws or of reviving the practice of rewashering customers' taps without charge (para 5.10, page 14). Views are invited on these possibilities, and in particular on whether the reductions in demand they might achieve are likely to be cost-effective from the company's own point of view, or alternatively would be justifiable if environmental benefits are also taken into account.

SAVING WATER INSIDE THE HOME

6.1 Household use accounts for half the water used from public supplies, equivalent to about 40% of all the water abstracted for purposes other than industrial cooling (chapter 3). This makes it vital to assess and exploit the full potential for reducing water use in the home.

6.2 Some of the possibilities discussed in the following two chapters would entail adding new legal requirements to the Water Byelaws or the Building Regulations (see chapter 9), or modifying existing requirements. In other cases substantial savings could be achieved through day-to-day actions by individual citizens if they have the appropriate information and the appropriate motivation. Their motivation to save water will of course be increased if their supply of water is metered (see chapter 11). But the introduction of some of these measures could lead to significant reductions in demand even in areas in which water is not generally metered.

Flushing toilets

6.3 Around a quarter of all water put into the public supply is used for flushing toilets and urinals. Water Byelaws prescribe limits for the maximum amount of water that can be delivered from toilet cisterns. The majority of toilet cisterns in England and Wales deliver a flush of approximately 9 litres (2 gallons). Where such cisterns are replaced without replacing the WC pan at the same time, a cistern of similar capacity may be installed. However, new Water Byelaws introduced in 1988/89, require a new single flush toilet cistern, installed at the same time as a WC pan, to deliver no more than 7.5 litres per flush. Research by the Building Research Establishment published in 1987[8] indicated that a number of close-coupled and low-level WC pans available at that time were capable of performing well with a 6 litre flush; some also functioned well with a 5 litre flush; and that, with design modifications to the WC pan, flush volumes below 5 litres ought to be achievable.

6.4 It appears that there is scope in reducing the amount of water used for flushing toilets quite considerably in the long term. Some impetus for manufacturers to produce lower volume flush toilets may come from selective metering. In addition, the Building Research Establishment Environmental Assessment Method (BREEAM) is a voluntary, self funding scheme for assessing the environmental quality of buildings which includes an assessment of water consumption*. But to speed up the introduction of low volume flush toilets it may be necessary to make regulations prescribing a reduction in the maximum volume of water that may be delivered from a toilet cistern installed after a specified date.

6.5 There is also the possibility of reducing the consumption of existing cisterns. Water shortages in 1976 brought about pleas for householders to place a brick in their toilet cistern in order to achieve a reduction in volume of the flush. However, the amount of water required to clear a WC pan is closely related to the design of the pan, and there are a number of problems with such a measure: repeat flushing may occur if the first flush volume is inadequate to clear the pan, the space required may make it impossible with some designs, and there is the possibility of fouling the mechanism. There are a small number of proprietary devices which claim to overcome some of these problems by using a plastic bag filled with water, sand, gravel or stones. Adjusting the ball valve is another possible alternative. While some toilets may function adequately using one or even two litres less water such measures should only be used if there is clearly no malfunction of the cistern and a greater volume of water is not being used through the need to flush more than once to clear the pan.

6.6 The installation of new dual-flush cisterns (other than for straight replacement of existing similar cisterns) is prohibited by Water Byelaws after 1 January 1993. These cisterns are designed to deliver a full flush of 9 litres (2 gallons) and a reduced flush of about 5 litres. Although it may take some time for people to become accustomed to the way in which these cisterns operate, so far as is known (apart perhaps in households with young children) their use has not given rise to any appreciable difficulty or inconvenience where they are installed for household use. The situation is however different in non-household installations where it is more difficult to educate people about the operation of dual-flush cisterns and there is a tendency to press the lever and walk away. The change in the Byelaws is due to the reduced consumption which conventional single flush toilet cisterns are capable of delivering and the fact that repeat flushing may be necessary if a short flush is mistakenly selected. However, it is understood a dual-flush cistern and WC pan which operates on a maximum flush of 6 litres and a reduced flush of 4.5 litres has been developed, accepted and used in other countries. It is proposed to initiate a small trial of reduced volume dual-flush toilets with a view to allowing their use initially for household use only.

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*Three versions currently exist covering new offices, superstores and homes. Features in the design and specification which contribute to positive environmental performance are rewarded with credits and a certificate is issued. In this way designers and developers are encouraged to produce more environmentally friendly buildings and provided with a way of achieving recognition in the market place. The New Homes and Superstores versions recognise the importance of water economy by awarding a credit for toilets with flushing capacity of 6 litres or less and, in the case of new homes, providing an approximately specified rain water collection butt.

6.7 In Europe extensive use is made of flushing valves to flush WC pans and urinal stalls. These valves are manually operated and deliver water at mains pressure for the time the valve is depressed. Flushing valves are prohibited for use in UK because early trials demonstrated that as they delivered water at mains pressure without any control over the volume of water delivered they tended to use more water. They also required regular maintenance, and if they failed, they did so in the open position resulting in considerable waste of water. However, there are indications that design improvements have overcome many of the problems which led to their prohibition in the UK. A WC pan designed for use with the higher pressure of water delivered by a flushing valve would not be limited to the 3 to 4 litre minimum that a conventional UK syphon needs to operate. European standardisation may bring pressure for their introduction in this country. New research is necessary by way of a properly designed and controlled field trial of flushing valves.

6.8 A research paper published by BRE in 1978[9] indicated several water economy measures for toilets and urinals, including waterless types, were worthy of greater use in this country. So far as can be ascertained little further work has been done in this area. DOE will review the current state of knowledge and consider whether field trials should be undertaken.

Personal washing

6.9 Around one fifth of water supplied is used for personal washing. Almost all of this is drawn from a hot water tap and, because of long pipe runs from the hot water storage cylinder, a considerable quantity of cold or tepid water is normally run to waste before hot water comes from the tap. Cold water is often then added to reduce the temperature to an acceptable level. This is wasteful of both water and energy. Public education about utilising the initial cold water (which also reduces condensation) could achieve significant savings

6.10 Better design of hot water installations, the use of instantaneous water heaters in situations where long pipe runs are unavoidable, and the use of small bore piping in conjunction with unvented water heaters can all contribute to economy in both water and energy use. This may be achieved by education of water engineers, architects etc. by teaching institutions, in codes of practice, and by tightening further the appropriate design standards, although the latter may be more difficult in the light of European standardisation (see Chapter 9). Alternatively, consideration might be given to making appropriate provisions in regulations.

6.11 The average amount of water used for a bath is around 80 litres (17.5 gallons) while an average shower uses only about 30 litres (6.5 gallons). Only 25% of domestic properties are currently estimated to be fitted with a shower and on the face of it significant water and energy savings would occur if all households had a shower fitted. However, this is only true where the frequency of use is substantially the same, a simple shower and not a power or multi-head shower is used, and the length of time under the shower is limited to a reasonable period. These criteria are most likely to be met in properties which are metered and, as most water companies meter new properties, consideration might be given to a requirement that all new properties are fitted with a shower (as well as a bath) and that existing properties which are metered might be eligible for grant to install a shower. Instantaneous thermostatically controlled showers run off the mains water supply provide easily controlled water temperature and avoid some of the initial waste often experienced with mixer valves while adjusting to the optimum water temperature.

6.12 Further savings may be achieved by educating consumers not to leave taps running unnecessarily. The wider use of quick-action taps which only require a quarter turn to operate, and which are particularly easy for children to turn on and off, could further aid water saving although they also tend to be turned fully on each time. Savings may also be achieved by the use of pressure reducing fittings and flow restrictors.

Washing machines and dishwashers

6.13 The proportion of households owning water using appliances has increased markedly over the last 10 years. It is currently estimated that 85% of households own a washing machine and 10% a dishwasher. Washing machines alone account for about 12% of domestic water use. No figures are available for use by commercial washing machines in the service sector but considering the number of machines that must be installed in hospitals, hotels, laundries, launderettes, etc. the amount is probably significant. Water Byelaws set limits on the amount of water which may be used by such appliances connected to water supply installations. Despite manufacturers marketing claims of environmental friendliness, washing machines and dishwashers are heavy users of water. It is however possible that the current byelaw maxima could be reduced as a result of technological advances since the model Byelaws were developed during the early 1980s.

6.14 In order to be able to choose those appliances which are most efficient in the way they use water, consumers need more informative labels. Water efficiency and energy efficiency usually go together. The European Community ecolabelling scheme will be launched later this year. Washing machines and dishwashers are likely to be amongst the first products to be eligible for the award of a label. To gain the award they would have to meet the environmental criteria agreed between member states. Proposals for such criteria have been made by the UK on the basis of assessments of the environmental impact of the production, use and disposal of these machines. The proposals, which are similar for the two product groups, concentrate on the impacts of the machines in use and include amongst the key criteria a high standard of water efficiency. The proposals would also set secondary, best practice criteria. Amongst these, manufacturers would be required to provide clear information to the consumer on the most economical way to use the machine including use of a full load. The introduction of metering may bring more pressure from customers for UK appliance manufacturers to reduce the amount of water used by appliances.

6.15 Some savings may be achieved by educating the public to use washing machines and dishwashers only when there is a full load or, where it is necessary to use a machine with less than a full load, to utilise half load or economy features where such features are provided. In addition, where clothes and dishwashing is by hand, it would help to use a bowl rather than the sink. There may also be some scope in reducing the size of sinks and basins, there is some move towards this with the current trend of providing two smaller sinks in kitchens. Night use of appliances, although not a conservation measure, helps reduce peak water and energy demand and under certain electricity tariffs may also give considerable cost savings.

The scope for further action

6.16 The largest single use of water (apart from industrial cooling) is the flushing of toilets by households. There is scope to reduce significantly the amount of water used for this purpose. Some measures may only be cost effective where water meters are installed but some ways of reducing water use do not cost anything or reduce benefit to the user and significant savings can be achieved.

6.17 Householders should consider the replacement of old inefficient toilets with modern low flush models. With care, adjustment of the ball valve or the introduction of a suitable device into an existing toilet cistern may save a litre or more of water at each flush (para 6.5, page 15) but such measures must not interfere with the flushing mechanism and must be discontinued if a second flush is found necessary to clear the pan.

6.18 Installing an instantaneous thermostatically controlled shower may reduce water use if frequency of showering does not exceed that for bathing and the shower is not run for long periods (para 6.11, page 16). Simple measures such as not leaving taps running unnecessarily (para 6.12, page 16), using a bowl in the sink (para 6.15, page 17) and utilising initial cold water from the hot tap (para 6.9, page 16) do not cost the customer anything and can save a significant amount of water over a year.

6.19 When purchasing washing machines or dishwashers it would be helpful for purchasers to look for those which use least water (para 6.14, page 17), only use them when they are full, unless economy features provide water and energy savings for a half load, and use them at night whenever possible to help reduce peak demand for both water and energy (para 6.15, page 17).

6.20 The current Water Byelaws prescribe maxima for toilet cistern flush volumes and water usage in washing machines and dishwashers. Can these volumes be reduced now, or in the near future, to take advantage of recent technological developments or to force the pace of developments, in water economy measures (paras 6.3 & 6.13, pages 15-16)? Should Water Byelaws be amended to allow the continued installation of dual-flush toilets in households (para 6.6, page 15)?

6.21 The Department of the Environment will initiate trials of low volume dual-flush toilets, flushing valves and, other toilets which are economic in their water requirements (paras 6.6 to 6.8, pages 15-16).

6.22 Views are invited on how to promote better design of hot water systems (para 6.10, page 16) and on public education about water saving measures generally.

PRIORITY AREAS FOR SAVING WATER

7.1 OTHER USES OF WATER, ALTHOUGH LESS IMPORTANT PARTS OF THE TOTAL PICTURE, MAY OFFER SCOPE FOR LARGE PROPORTIONAL SAVINGS AT RELATIVELY LOW COST. PRIORITY AREAS FOR ATTENTION ARE GARDENING, INDUSTRIAL PROCESSES, AGRICULTURE, URINAL FLUSHING AND IMPROVED MAINTENANCE.

External use

7.2 Although on average only a small proportion of water put into supply is currently used for external purposes there are indications that the volume is increasing. Increased ownership of cars will have led to more water being used for car washing. There has also been a marked increase in interest in gardening which, coupled with the recent dry summers, will have led to an increase in the amount of water used for garden watering. An increase in the number of swimming pools and garden ponds has also contributed to greater external use. A large proportion of water used externally is delivered through a sprinkler or hosepipe which may use up to 1,000 litres (220 gallons) per hour. Use of water externally peaks dramatically during a three to four month summer period creating severe supply problems.

7.3 The most effective way of influencing external household demand, other than by imposing a hosepipe ban, is to meter the supply and introduce a seasonal tariff. Public education not to over-water gardens, to accept that longer grass is more drought resistant, to water in the evening so as to reduce evaporation, to use watering cans rather than hoses and not to leave hoses running unnecessarily while washing cars would also contribute to a reduction in external use where water supplies are unmeasured. A requirement that hosepipe discharge be controlled by a trigger actuated valve might inhibit excessive use, or misuse.

7.4 There is also considerable non-household external use of water such as for watering public parks, gardens and golf courses. While such uses may be curbed by the occasional limitations imposed under drought orders, arguably water in the public supply system treated to high standards should not be used for such purposes or even for household gardens.

7.5 Substantial amounts of water both from direct abstraction or from the public supply system are used for agricultural purposes. There is considerable potential for reducing these amounts by increasing the effectiveness of spray irrigation.

Urinal and toilet flushing

7.6 Whereas toilets are fitted with individual manually operated cisterns, it is normal practice for urinal installations to be fitted with an automatic flushing cistern serving a group of urinal stalls or bowls. The frequency of operation of such cisterns generally depends on control over the rate of filling. Water Byelaws prescribe the maximum rate at which such a cistern may be filled. Byelaws also require a means of preventing inflow of water to the cistern during times when the urinals are not in use, for example at night or weekends. This can be achieved by a time switch or by automatic control systems initiated by movement.

7.7 It is common practice in some European countries for individual urinals to be flushed when required as a result of detection by infra-red sensor. Such systems are believed to require considerably less water than the UK system of periodic group flushing. Although the current UK Byelaws require a time switch or similar control to shut down urinals outside normal working hours, that provision has two major weaknesses: the provision is not retrospective for installations prior to 1989 and it is likely that some 90% of installations are not so controlled and; where shutdown systems are installed there is no monitoring of their proper operation. Time switch settings may therefore be incorrect and not differentiate between working and non-working days. The majority of urinals will be in properties with a metered water supply and in many cases the cost of installing more sophisticated equipment will be cost effective over a relatively short period. Significant water savings could be achieved by widespread installation of urinal control systems. Consideration should be given to making the present Byelaw provisions retrospective and requiring periodic inspection of the control mechanism.

7.8 The BREEAM system referred to in paragraph 6.4 above does not currently cover the installation of low flush toilets in new office buildings. A revision of the new office version of the scheme is planned and will include credit for toilets with a 6 litre or less flushing capacity.

Maintenance

7.9 The volume of water wasted from poorly maintained installations can be considerable. There is an incentive in properties that are metered to ensure water is not wasted from poorly maintained systems, but where water is charged on an unmeasured basis, more regular Water Byelaw inspections could be undertaken and, where remedial maintenance is not carried out within a reasonable period, enforcement action, which can include compulsory metering, could be pursued. However, the cost of regular inspections of all unmetered domestic properties would be high and may not be cost effective. It may be more effective to select an area, give local publicity to the Byelaw provisions and carry out selective spot checks on Byelaw contraventions.

7.10 Unless the case constitutes an emergency, in which case the water company has power to disconnect the service pipe, any contravention of Byelaws requires the serving of a notice specifying what steps are required and giving not less than seven days for the specified action to be taken. If the owner or occupant of the property fails to take the required action the water undertaker may carry out the necessary work and charge the occupant or owner accordingly. The procedure is fairly cumbersome and if the case concerns the waste of water considerable volumes may be lost while the formalities are completed. There are also restrictions on the power of entry to domestic premises. As a result little or no enforcement takes place in this area. There may be scope for making it easier for water companies to deal with waste of water on customers' property by extending the powers of entry in such circumstances without creating a situation of excessive intrusion

Building and estate management

7.11 The CBI have published a booklet entitled *Efficient water management, Guidelines for business*[10] which offers practical suggestions on what can be done and where savings can be made. More thorough and detailed guidance about the efficient use of water in buildings and on estates may be of use to building control managers. In areas where water is in short supply an audit of water saving possibilities by major users, carried out by water company inspectors or consultants, might produce significant savings.

The scope for further action

7.12 Although relatively small as a proportion of the total put into supply, the external use of water contributes to the severe demand problems during the summer period. Measures to curb external demand or reduce waste could include compulsory metering for households who want to use a hose, regular summer public education campaigns about the most effective use of water in gardens, and a Byelaw requirement for hoses to be actuated by a spring loaded trigger mechanism (para 7.3, page 18). More attention could be given to the effective use of water for agricultural purposes and farmers could be encouraged by ADAS and NRA to use more efficient crop watering techniques (para 7.5, page 18)

7.13 The installation of more sophisticated urinal control systems and low flush toilets in metered non-household properties can be cost effective over a relatively short period of time. The installation of basic urinal control systems could be made mandatory along with periodic inspection of the system (para 7.6, page 18, and 7.7, page 18). The installation of less than 6 litre flush toilets in new offices should be covered in the forthcoming revision by BRE of the new offices version of the BREEAM system (para 7.8, page 18)

7.14 There is little incentive to maintain water installations where the supply is not metered. A system of spot checks following publicity in an area could be more effective and less costly than periodic inspection of all properties (para 7.9, page 18). Water company powers of entry to deal with leaks on customers' premises will be reviewed.

7.15 Where the water supply to a building is metered, some of the measures discussed in this chapter could bring about significant cost savings for occupiers. More publicity needs to be given to that aspect. More thorough guidance on the efficient and cost effective use of water in buildings and estates should be made available to managers responsible for building and estate maintenance. DOE will discuss with the water industry and relevant professional bodies how that can best be done.

RECYCLING AND RE-USE

8.1 The demand for water could be reduced by making greater use of recycling. Although at present all public supplies of water are to the high standards required for drinking and food preparation, most uses do not actually require that standard of water and it is worth exploring the potential for using lower quality water for those purposes with little or no treatment.

Industrial processes

8.2 A large proportion of the water used for industrial purposes is abstracted directly under licence. Much of that, for example water used for cooling, is returned directly to rivers and may be abstracted again further down-stream for other purposes. However, large quantities of water both from direct abstraction and from the public supply system are used in industrial processing and are not returned directly to rivers. Much of the waste water which has been used for industrial processing contains high levels of chemicals, organic matter and metals. Traditional methods of waste water disposal such as dilution and dispersion into rivers are being questioned as new evidence of environmental damage emerges. Tougher water quality standards for effluent are pushing up expenditure on waste water treatment. There is obvious scope for treating and reusing waste water in large scale industrial processing. Straightforward, relatively simple improvements to practices inside processing plant may also bring about substantial savings in water use. As virtually all industrial use is metered, the volume of water taken into the premises is also used as the basis for payment of sewerage charges. The benefits of reducing use have implications for savings in both the cost of water and sewerage. Industry needs to be educated about the benefits and encouraged to manage water use.

8.3 It may also be appropriate to consider whether in certain circumstances the recycling of water should become mandatory. As an example, significant amounts of water (and detergents) are used by commercial car wash or vehicle wash units for fleet operators such as bus companies and hauliers. Recycling systems for such units are available and consideration could be given to requiring such systems to be fitted to all new units together with an incentive for existing units to be converted.

Using sea or river water

8.4 There is, of course, no necessity for water used in toilet flushing to be treated to the same high standards required for uses such as drinking, cooking, food preparation and washing. In Gibraltar, for example, where because natural resources are insufficient to cope with demand and the bulk of potable water is produced by desalination, a separate supply system providing minimally treated sea water serves sanitary appliances. Such a system in England and Wales would require the laying of a separate new mains network and extensive internal replumbing of properties. Even in coastal towns it would be very costly to install and may not be economically justified. Such systems would also increase the risk of contamination of potable water supplies through cross connection. But because so much water is used for flushing toilets and urinals the commissioning of an economic assessment of such a system should be considered.

8.5 Electricity generating stations are major users of treated water from the public supply and high quality groundwater direct from aquifers. Other water, such as river or sea water, may be readily available and, with new technology, may be economic to treat to standards required for use in boilers.

Re-using water

8.6 Almost all water put into supply, apart from that lost through leakage, is returned to sewage works after use for treatment and disposal into rivers or coastal waters, as is the vast amount of rainwater which falls on roads, paved areas, hardstandings and roofs. Much of this water could be used for purposes such as toilet and urinal flushing, garden watering and some industrial processes where water treated to potable standards is not required. In domestic property water used for washing (personal and clothes) and rainwater could be reused for toilet flushing or for garden watering. There are potential health problems if such water is stored in open tanks. However, closed storage and minimal local treatment might overcome any health risk, and the potential savings in water could be significant. The recycling of hot water also raises the potential of energy recovery. The Chartered Institution of Building Services Engineers (CIBSE) allocated over £50,000, donated by Thames Water, for a research contract awarded to BSRIA to determine the feasibility of recycling household water. It is understood that the results indicate recycling to be an economic proposition for larger users such as hotels and guest houses but that it may not be an economic proposition for households.

8.7 The increased use of soakaways for rainwater falling on hard surfaces would reduce the volume of water treated in sewage works and could assist in replenishing aquifers. The re-use of rainwater in coastal towns may warrant particular attention as such water is almost entirely lost either by direct flow into the sea or through sewage works which discharge into the sea.However, it will be important to ensure that such water has not become contaminated, for example by pesticides.

8.8 Water butts on domestic property can store rainwater run-off from roofs for garden use. Water used for personal or clothes washing may also be stored in this manner but in order to avoid any health risk such water should only be stored for short periods. Kits are available to divert such water from discharge pipes.

8.9 There may be more scope in increasing the use of effluent from sewage works for agriculture to reduce the amount of direct abstraction for such purposes, although this is only likely to be economic within a small radius of the works.

The scope for further action

8.10 The greatest contribution to water savings through recycling and re-use can be made by industry and the service sector. In many instances sewage effluents may comprise a significant water resource if discharged, suitably treated, to a watercourse upstream of a point of abstraction. Consideration might therefore be given to strengthening NRA's powers to control where discharges take place, or else providing financial incentives to firms to make discharges at the most desirable place in terms of overall management of water resources.

8.11 The greater use of untreated water, particularly sea water, may be economic in some cases.

8.12 The main way in which progress will be achieved is through firms responding to cost signals. Recycling and re-use will be encouraged if incentive charging schemes are introduced for discharges and/or (as discussed in chapter 10, pages 24-26) for abstractions.

8.13 Views are invited on other ways in which recycling and re-use of water by industry and commerce could be effectively promoted, for example by more extensive publicity and guidance (para 7.15, page 19).

THE FUTURE OF WATER BYELAWS

9.1 There are Water Byelaws to prevent waste and contamination of water. They control plumbing materials and installations. The content is standard but enforcement is by individual water companies. The role of the Water Byelaws now needs to be re-examined in the light of water privatisation and the increased emphasis on economising in the use of water.

9.2 The present system of Water Byelaws is described in more detail in Appendix 1 (paras 22 and 23, page 33). The powers to make or amend Byelaws were repealed by the 1989 Water Act on the assumption that they would be replaced by national Regulations made by the Secretaries of State for similar purposes under what is now Section 74 of the Water Industry Act 1991. This section leaves it open whether such Regulations would be enforced by water companies or by local authorities (either separately or concurrently) or whether duties with respect to enforcement might be placed (separately or concurrently) on other prescribed persons. As there may be some points on which the Byelaws will conflict with European standards (see below), and as a case can be made for amending the Byelaws to deal with further types of situation now identified as likely to lead to contamination, the Government will need to take decisions in the near future about whether Regulations should be made, and if so their content.

9.3 There are a number of possible options available for the replacement of the Water Byelaws:

i. dispense with legislation for preventing waste, undue consumption, misuse or contamination of water, and rely on general observance of a model specification drawn up by an authoritative independent body (comparable to the Institution of Electrical Engineers' rules for electrical installations) in conjunction with the EC Construction Products Directive and European and British standards;
ii. rely on a code of practice drawn up and enforced by the water industry;
iii. subsume legal requirements about waste, undue consumption, misuse or contamination in the Building Regulations. Powers already exist for this purpose in Section 1 of the Building Act

1984, although they are less comprehensive than Section 74 of the Water Industry Act 1991;

iv. make Regulations under Section 74 which are as near as possible in content to the Water Byelaws, apart from any detailed amendments necessary;

v. make Regulations under Section 74 which would follow the general approach of the Building Regulations by being in very broad terms and supported by Approved Documents endorsed by DOE;

vi. as a variant of iv or v, extend the scope of Section 74 so that the new Regulations could also include requirements about plumbing for waste water, which is at present covered in the Building Regulations.

9.4 Although the present consultation paper is not concerned with contamination risks, it would be undesirable to divide up responsibility for the two aspects of water supply installations, waste and contamination, which are integrated in the present Byelaws. From both aspects there would in fact be some advantages in establishing a closer link between regulation of water supply installations and regulation of waste water installations. This would for example make it much easier to promote and control the recycling of household water, which may become a significant factor in future.

9.5 The repeal by the 1989 Water Act of the power to make Water Byelaws was the outcome of the Government's view that it would not be appropriate or acceptable for legislation about household plumbing to be made by private sector companies. It can be argued that it would also be inappropriate for the water companies to remain responsible for enforcing Regulations on this subject, especially as that responsibility could extend to authorising relaxations of, or departures from, the normal requirements; but that was a possibility which the 1989 Act has left open.

9.6 There are practical and operational arguments for maintaining a continuing close involvement by water companies in preventing contamination of their water supplies. On the other hand, there is little information available at present about the effort water companies are devoting to Byelaw enforcement: the Drinking Water Inspectorate is seeking to fill that gap. It is possible that a higher level of enforcement is warranted particularly with regard to the prevention of waste. There have been no recorded prosecutions in the recent past under either heading. Effective enforcement represents a cost to water companies without necessarily any offsetting savings elsewhere or any corresponding increase in revenue. As any net additional costs would have to be met by water company customers, the cost-effectiveness of an increased enforcement effort would have to be assessed.

9.7 The alternative approach would be to make local authorities responsible for enforcement in this field. The further step could then be considered of incorporating legal requirements about waste and contamination into the Building Regulations. This would have the advantage of making it possible to integrate responsibility for water supply and waste water installations from an early date, without any further primary legislation, and adapt and extend them to cover the potential for domestic recycling of water.

9.8 The Building Regulations however apply at present only to new building and certain alterations and extensions to existing buildings. The Water Byelaws on the other hand have a continuing application to all customers of water undertakers. There is power in Section 2 of the Building Act 1984 to extend the Building Regulations into a form of continuing control; but that would have very significant policy and resource implications.

9.9 A further option which should also be considered therefore is that the responsibility for enforcement might be shared between local authorities and water companies. Where a new building is being constructed, or an existing building altered or extended, the local authority would be responsible under the Building Regulations for enforcing statutory requirements designed to prevent waste or contamination of water supplies. The water company on the other hand would have a continuing responsibility for enforcing requirements designed to prevent waste or contamination of water supplies occurring as a result of the way in which the plumbing installation in a building is being used or operated. The responsibility for preventing unlawful modifications to the plumbing installation might be given to the local authority and the water company concurrently.

The impact of European standards

9.10 In the long run the role of national regulations in this field will be considerably affected by the EC Construction Products Directive, implemented in the UK by the Construction Products Regulations 1991 (which came into effect on 27 December 1991). This Directive is a major element in opening up the Single Market. In practice the pace of change depends on how rapidly standards are drawn up by the European standards body, the Comité Européen de Normalisation (CEN), for the purposes of the Directive.

9.11 There is a danger that CEN standards will not adequately reflect existing UK practices. This is because there has historically been a major difference of philosophies between the UK and continental Europe. The UK was the first major state to develop controls over the public water supply system. Essentially the UK system is characterised by a relatively simple system of low pressure and internal storage. In contrast the continental system, which was developed later and utilised newer technology, operates at higher pressure and generally dispenses with internal storage. As a result the continental system is more complex, requiring mechanical backflow protection as opposed to the air gap associated with cistern storage, and temperature and pressure relief valves on heating systems as opposed to the valveless vented systems customary in UK. The consequences of greater complexity on the continent include tighter regulation of plumbers, annual maintenance requirements by approved personnel and obligations on the owners or occupiers of property with respect to the operation and maintenance of plumbing systems.

9.12 The approach to saving water on the continent has also developed along different lines, as a result of differences in the supply system, and also because water is generally more costly and supplies are almost universally metered. Leaks on customers' premises therefore have significant financial consequences for them. And customers apply pressure on manufacturers to develop appliances which use less water. In some parts of Germany the water undertaker actively promotes water savings by giving advice to customers on which appliances use least water.

Scope for further action

9.13 The role and form of the Water Byelaws needs to be reviewed. Although there are several possible options for the future (para 9.3, page 21), it is proposed that, following the existing model provided by the Building Regulations, they should be replaced by national Regulations in broad terms supplemented by Approved Documents. Views are invited on whether (paras 9.4-9, page 22):

i. they should be integrated with the provisions of the Building Regulations covering waste water or retained as a separate code;

ii. responsibility for enforcement should lie with water companies or with local authorities, or be shared.

9.14 UK representatives on CEN committees (who normally come from water companies and from manufacturers) will need to press hard to gain recognition for UK technical traditions, including products and design practices specifically developed for our low pressure system which have been developed to combat waste. DOE will maintain close liaison with the Water Services Association and the British Standards Institution in order to ensure that this happens.

MATCHING SUPPLY AND DEMAND

10.1 MATCHING SUPPLY AND DEMAND FOR WATER COULD PROBABLY BE ACHIEVED MUCH MORE READILY AND EFFECTIVELY IF THERE WERE APPROPRIATE COST INCENTIVES TO ENCOURAGE ITS EFFICIENT USE. TO WHAT EXTENT ARE THERE SUCH INCENTIVES AT PRESENT? IF THEY DO NOT EXIST, CAN ACCEPTABLE ECONOMIC INSTRUMENTS BE DESIGNED AND INTRODUCED?

Expressing demands

10.2 To achieve a rational balance between conflicting objectives, we need to know what the real costs will be of adopting particular courses of action. That means, not only the full financial costs, long-term and short-term, of obtaining, processing and distributing extra supplies of water, but also the costs likely to be imposed on the environment. The impact on the environment is in fact likely to vary considerably from place to place. To the extent that people wanting to use water are faced with its real costs, and people able to provide water can cover the real costs of doing so, price mechanisms can be a powerful instrument in helping to bring about greater efficiency in water use. At the moment however such forces operate only to a very limited extent in this field.

10.3 There will be a limited financial disincentive to new development where water charges are higher because the water companies concerned have large investment programmes, but the size of these programmes will reflect a number of other factors besides the cost of developing new sources. There is also the system of infrastructure charges introduced by the 1989 Act: new customers pay the company a fixed amount on connecting as a contribution towards the costs of the additional non-local infrastructure (reservoirs and treatment works) required to provide water supplies for them (and similarly for sewerage). The size of the infrastructure charge reflects the amount a particular company is having to invest in non-local infrastructure. On the other hand the present system of abstraction charges paid to NRA by water companies and other licensed abstractors fails to reflect the environmental costs of existing or new abstractions.

Charging for water abstracted

10.4 Abstraction charges were introduced along with the licensing system by the 1963 Water Resources Act. The size of the charges varies from region to region, and also according to the relative hydrological impact of abstractions for different purposes. Charges are higher for spray irrigation for example, because a high proportion of the water abstracted is absorbed by plants or evaporates; but lower for water used for cooling, which is often returned to a river at almost the same point. There are two reasons why the present system nevertheless fails to provide appropriate financial incentives:

i. charges are paid solely on the basis of the amount of water licensed for abstraction, and do not reflect the amount actually abstracted (with the exception of most charges for spray irrigation, which take into account both factors);

ii. in setting charges, NRA's duty is to meet the annual costs (about £70m) of carrying out its water resources functions. These include licensing and monitoring of abstractions, operation of the hydrometric network, payments in respect of the reservoir operating agreements with the water service companies, resource planning, and a variety of related activities. As these costs are much higher in the case of sources in which NRA supports abstractions (most often by regulating river flow), the charging scheme proposed by the NRA to come into effect from April 1993 will incorporate a large differential between licences for unsupported sources and licences for abstractions from supported sources.

The effect is that the charges payable do not bear any relationship to the full costs imposed by particular abstractions, including the costs imposed on the environment. In fact the existing charges are equivalent to no more than about 3% of the price the ordinary customer pays for water.

10.5 There is an analogy here with the use of economic incentives to help control water pollution. The Royal Commission on Environmental Pollution advocate that in their recently published report on *Freshwater Quality*[11]. A charging scheme has recently been introduced to meet the annual costs of carrying out NRA's pollution control functions. Studies are now being carried out to assess whether it would be feasible and acceptable to introduce a more far-reaching charging scheme which would provide an incentive to firms discharging effluent to minimise the impact of their discharges. DOE will be publishing a consultation paper in the autumn to carry thinking forward on this complex subject.

10.6 The Government are also giving further thought, in conjunction with NRA and OFWAT, to the possibility that the same principle might be extended to abstractions of water. This could take the form either of a separate scheme or of a combined scheme covering both discharges and abstractions (which would reflect the linkages between the two for example in relation to dilution factors).

10.7 If it is too inflexible the licensing system for abstractions can in itself represent an obstacle to the more efficient use of water. The existence of a licence means that NRA is precluded from granting any further licences which would derogate from the abstraction rights it confers. Situations can arise in which the current holder of a licence may not have an immediate requirement for the whole amount of water he is authorised to abstract. NRA does grant time-limited licences for quantities of water which are covered by an existing licence but are not currently being used by the licence-holder. However that does not cover another type of situation in which the purpose for which an existing licence-holder requires water may have a lower value than proposed new uses. To deal with the latter type of situation, it has been suggested that either licences should be auctioned periodically or there should be arrangements for licences to be traded between licence-holders, or between a licence-holder and a would-be licence-holder.

10.8 The purpose of the licensing system is to ensure that the use we make of water resources is sustainable. But many abstractions take place under licences of right which were granted automatically under the 1963 Water Resources Act because a right to abstract had been established previously. And the unprecedented dry spell has created a general deficiency in water resources in a number of areas and aggravated deficiencies which already existed. Where there is reason to believe that over-abstraction may be occurring, NRA has power to revoke or vary a licence. The licence-holder may appeal to the Secretary of State against revocation; and, if the licence is revoked, may claim compensation from NRA for financial loss or damage he has sustained as a result.

10.9 Any compensation paid in such circumstances will be funded from NRA's regional water resources account. As the majority of water abstracted is for public water supply, most of the cost of paying compensation will be met by the customers of water companies.

10.10 NRA has identified 40 rivers in England and Wales in which it considers the low flows are the result of excessive abstraction as well as the unusually dry weather. It has said that it will take positive action unless an early voluntary agreement is reached with water companies on measures to reduce these problems. Where variation or revocation of abstraction licences is necessary and abstractors can establish legal rights to compensation, NRA will charge the cost of compensation to the water resources account, to which all abstractors in the relevant region contribute. A balance will need to be struck between the need to reduce damage to the environment from over abstraction, and the interests of consumers, who will ultimately bear the cost.

10.11 In the case of water companies, greater flexibility in the redistribution of water should now be possible as a result of powers given to the Director General by the Competition and Service (Utilities) Act 1992. He can now, after consulting NRA, order a water company to provide a bulk supply of water to another water company on appropriate terms and conditions. He can also make an order terminating or modifying an existing bulk supply arrangement. These powers could also be used by the Director General to promote local competition in the water industry by ensuring that a bulk supply of water is made available to a would-be new entrant seeking an inset appointment as a water undertaker. These new powers however do not override the system of abstraction licensing.

The scope for further action

10.12 It is desirable to increase the extent to which economic instruments can operate to bring about greater efficiency and help balance conflicting demands and objectives in relation to water use. It is also clear that much work still remains to be done to identify suitable instruments; and that if introduced these would take time to have effect.

10.13 The Government will give consideration to the possibility of an incentive charging scheme for abstractions (para 10.6, page 25). If such a scheme were in operation, it could have the effect that a water company or other abstractor would have to make a payment equivalent to the full cost of the water abstracted, including environmental costs. Further consideration also needs to be given to ways of making the licensing system itself more flexible (para 10.7, page 25).

10.14 The Director General is consulting the water companies at present about the way in which he intends to use his new powers over bulk supplies (para 10.11, page 25).

10.15 Environmental statements for proposed water resources projects ought to include in their assessment of alternatives, where appropriate, the extension of metering and measures to reduce waste.

SHOULD WE PAY BY METER?

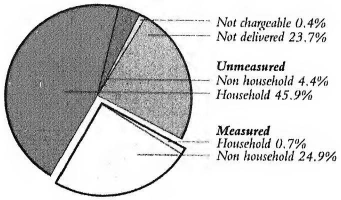
11.1 IF CUSTOMERS PAY FOR WATER BY VOLUME, THEY ARE IN A POSITION TO DECIDE HOW MUCH THEY WANT TO SPEND ON WATER. THEY HAVE AN INCENTIVE TO ECONOMISE IN THEIR USE OF WATER BY CUTTING OUT WASTE, AND TO SPEND MONEY FOR THAT PURPOSE UP TO THE POINT WHERE THE COST OF FURTHER WATER-SAVING MEASURES EXCEEDS THE AMOUNT THEY WOULD SAVE IN WATER CHARGES.

11.2 If their charge for sewerage is also based on the volume of water used, customers have an even greater incentive to use less water. (The normal practice in such circumstances is to deduct from the sewerage charge an allowance for water supplied to the premises but not returned to the sewers; at the moment this is usually 5%.)

11.3 Economies in the use of hot water are doubly worthwhile because they produce not only a reduction in the bill for metered water but also what will usually be a greater reduction in absolute terms in energy use and in the fuel bill.

11.4 In contrast to nearly all other countries, only 26% of the water supplied to customers by water companies in England and Wales is charged by volume. As the pie chart shows, commercial and industrial customers account for nearly all of that. The great majority of households still pay water charges based on the rateable value of their home on 31 March 1990.

Percentage of measured water delivered



Existing policies for extending metering

11.5 The three main categories of household customer who pay by meter at present are:

i. those who have moved into new or converted houses or flats since March 1990. Most water companies are requiring a meter to be installed and used in such cases, although a few have adopted other payment methods such as a flat-rate charge;

ii. those who have chosen to have a meter installed at their own expense in the expectation that this will reduce the charges they have to pay;

iii. the 57,000 customers living in one of the 12 areas used for the national metering trials which were initiated in 1988 with funding from DOE and the water companies. The Isle of Wight is much the largest of these areas.

11.6 The 1989 Water Act prohibited water companies from using pre-1990 rateable values as a basis for water charges after 2000. As yet no company has sought to change the basis of charging for existing customers. However, the Director General of Water Services has conducted an extensive consultation exercise on future payment systems[12]. Half of a random sample of households interviewed in a survey commissioned by OFWAT said that they wanted to pay by reference to the amount of water used. NRA also expressed support for the selective introduction of metering in areas where water resources are expected to be under pressure. Of the ten Customer Service Committees five favoured a general policy of metering.

11.7 In the light of the consultation exercise mentioned above the Director General published a strategy in December 1991[13]. He concluded that metering is the best solution for most properties in the longer term, although for some existing properties metering will never be economic and for these a system of charge bands related to water use may be preferable. He also concluded that a rapid switch to general metering would be unnecessarily expensive. He therefore advocated a selective approach, concentrating on:

i. areas where there are shortages in supply or where water resources are under pressure for environmental reasons;

ii. households where there is likely to be high discretionary use of water, for example those using garden sprinklers;

iii. dwellings where the cost of installing a meter is relatively low.

11.8 The key elements in the strategy are:

i. the extension of domestic metering selectively in places where the overall benefit to customers outweighs the costs. In some areas the cost of installing and reading meters may be less than the costs saved through being able to delay the development of new sources of water;

ii. encouraging a larger number of individual customers to opt for a meter. Some companies have already taken imaginative steps to promote this option: one offers a free meter if the customer pays for the installation, while another offers meter plus installation for a flat rate charge of £99;

iii. ensuring that tariffs do not discriminate against metered users and are related as closely as possible to water use. This might entail reducing the size of standing charges payable under metered tariffs, and also the size of lump sum contributions for connection to the system.

11.9 The Director General envisages that the switch to metering will not be complete by 2000. In some areas, as a transitional stage, rateable value based charges for households may well be replaced by a simple system of charge bands in which type of property will be taken as a broad indication of amount of water used, but with individual customers able to choose instead a well designed option to pay by meter. He has said that he regards metering as likely to be justified for all commercial and industrial customers, except where a customer's use of water is known to be consistently low; most water companies already require such customers to pay by volume. He is now discussing with individual water companies what their strategies should be towards the compulsory metering of supplies to households. Under present legislation however, and provided it does not show undue preference or discrimination, each water company has the discretion to determine the method of payment for those of its customers who do not opt to have a meter installed at their own expense.

The benefits of metering

11.10 Although the final report of the national metering trials will not be available until 1993, preliminary data show that the introduction of metering has been followed by significant reductions in the amount of water supplied. In the small scale trials, relative to the control areas, the average reduction in customer demand was 13%. By making subjective adjustments to the data, the reduction in customer demand was considered to be 8%. These figures do not include any reduction in leakage or other continuous demands. In a survey carried out for OFWAT and DOE in the trial areas[14], the majority of customers (59%) said that they had taken steps to reduce their use of water.

11.11 There are indications that metering may have had an even bigger effect on peak demands, reducing them by up to 20%. Peak demands on water supply systems are usually created by watering of gardens on hot summer evenings, which is a discretionary use.

11.12 Once a meter has been installed, there is potential for varying the amount charged to reflect variations in the economic cost of water in order to provide appropriate signals to customers. Data from the national metering trials suggest that bigger reductions in water use occurred where the tariff varied with the season or time of day (although there were sometimes technical problems with the recording equipment in the latter case) or where the unit cost of water increased at higher levels of consumption ('rising block tariff').

11.13 The installation of meters brought about reductions in leakage, partly because service pipes and stop-taps were repaired in the course of installing meters and partly because metering encouraged customers to remedy waste from their pipes. On the Isle of Wight, compared with 1988-89, the estimated reduction in customer demand (excluding waste) was 6% in 1990-91 (while meters were being installed), whereas Southern Water report an overall 20% reduction of water into supply in 1991-92.

Problems with metering

11.14 The widespread installation of meters would require major capital expenditure, and the ongoing costs of maintaining, calibrating and reading the meters would also be significant. In the national metering trials the average cost of installation was roughly £200 per dwelling, more than the annual average charge per household for water services. However extrapolating this figure to produce a figure of £4 billion for the cost of installing a meter in every dwelling in England and Wales is not valid: there would be economies of scale in a large programme, and in any event no one envisages that meters would be installed in every existing dwelling. The cost of installing meters as part of an existing programme for replacing mains and communication pipes would be very much lower as would a selective metering programme where savings from the deferment of resouce development could be taken into account. If meters were installed inside the house rather than on the underground service pipe outside, the unit cost could be considerably less than £200, although there would be disadvantages in other respects such as access by the company for reading. It is not possible to generalise about the best location, and companies need to be sensitive to the customer's wishes on this point.

11.15 Any change in the method of paying for water will create gainers and losers. In the national metering trials, 65% of customers have paid about the same or less than they would have paid under the rateable value system; but 20% of customers paid at least 20% more. The introduction of metering will tend to benefit small households, especially people living in a house or flat with a relatively high rateable value. It is likely to increase the cost of water for people, especially large households, living in a house or flat with a relatively low rateable value. The effect on large households will be magnified if a rising block tariff is used.

11.16 There have been claims in some areas where metering has been introduced that it can cause hardship for large families or for households containing someone who needs to use unusually large amounts of water because of a medical condition. A DOE-OFWAT survey[14] has investigated this aspect in the trial areas. It found that, although most households expressed support for metering, a very small proportion could be regarded as having suffered some form or degree of hardship.

11.17 An important finding from the survey is that customers often have a poor understanding of the most effective ways in which they can reduce their use of water and therefore save costs. This highlights the need for more public education about using water wisely, not only in areas in which metering is introduced, but also more generally.

The scope for further action

11.18 The more general metering becomes, the more a water company's revenue will depend on the volume of water it supplies. This has the advantage that increases in demand for water will then generate extra revenue which can be used to finance the development of new sources, without any need for an adjustment in K. On the other hand, reduction in demand as a result of water-saving measures by customers will lead to falling revenue and could make it difficult for a water company to cover the whole of its fixed costs.

11.19 The Director General has already published a strategy for the extension of water metering for domestic customers (para 11.7, page 27) and is discussing with individual water companies what their strategies should be (para 11.9, page 27). In addition NRA has said that it will now expect any water company applying for a significant new abstraction, certainly in areas where water resources are under stress, to have completed, and submit with the application, an assessment of the impact water metering may have on future demand.

11.20 There is a risk that a very small proportion of water company customers could suffer some form or degree of hardship if they have to pay for water by volume. The conclusions of the report mentioned in 11.16, page 28, will be carefully considered by the Government, together with possible ways of alleviating the kind of difficulties experienced by some households in the sample. Irrespective of whether metering is introduced, there needs to be more public education about the relative amounts of water used for different purposes, and the most effective and least disruptive ways of economising.

11.21 Having regard to the action already in hand, views are invited on the following forms of possible further action to promote water metering:

i. the assessment of the case for installing water meters in a particular area could be extended to include a wider range of factors. It should already take into account cost savings to the water company from not having to develop new schemes, if the effect of metering is to reduce demand. But the assessment could be extended to include in addition the environmental benefits from the reduced need to abstract and discharge water;

ii. the Director General could be given a new power to approve decisions by water companies about charging methods in order to secure that the charging methods are designed to promote economy and efficiency, and in particular the efficient use of water, taking into account the impact on the environment. This would require legislation;

iii. the ban on use of rateable values after 2000 could be extended to cover charging on the basis of council tax valuations (which would require legislation). Using council tax valuations as the basis for water charges would in itself create new groups of gainers and losers; and, in contrast to the possible interim system of charge bands envisaged in 11.9, page 27, the charges would not be designed to have any relationship to the amount of water used by a household;

iv. it might help to improve the overall economics of water metering if reliable techniques can be developed for remote reading of meters and/or if meter-reading could be carried out on a combined basis for several different utilities.

12.1 Many of the measures discussed in this paper require research, more detailed consideration, or a relatively long lead time before they make an impact on demand. This chapter summarises measures which are already in hand, those measures which Government intends to consider and the proposals to promote or investigate potential reductions in the amount of water used on which the paper specifically asks for views. It also summarises the measures that the general public can take, which could form the basis of on-going public education.

Measures in hand

12.2 Actions already taken include:

i. Elaboration and refinement of a water resources development strategy for England and Wales by NRA (para 4.19, page 11).

ii. Seeking early solutions to the 40 identified situations of low flows (para 4.19, page 11).

iii. Improvement and standardisation of techniques for assessing reliable yields (para 4.19, page 11).

iv Taking full account of the water resources implications in the preparation of regional planning policy guidance (para 4.21, page 12).

v. Development of a Code of Practice on leakage by the water industry which will assist water companies to decide on long term targets for leakage reduction (para 5.7, page 13).

vi. Pressure on water companies to reduce water loss from leaks as a result of the Director General's use of water delivered as an output measure and the importance NRA is placing on leakage control (para 5.11, page 14).

vii. Maintenance of close liaison with the Water Services Association and the British Standards Institution over content of European standards (para 9.14, page 23).

viii. Consultation between the Director General and the water industry about the way in which he should use his new powers over bulk supplies (para 10.14, page 26).

ix. Making it clear that environmental statements for proposed water resource projects should include, where appropriate, an assessment of the extension of metering and measures to reduce waste (para 10.15, page 26).

x. Assessment of the impact of water metering on demand which NRA expects when any water company submits an application for a significant abstraction licence, particularly in areas where resources are stretched (para 11.19, page 28).

xi. Publication of guidelines for the extension of household water metering by the Director General and discussions with individual companies on their strategies (para 11.19, page 28).

The next steps

12.3 The Department of the Environment and the Welsh Office, in conjunction as appropriate with NRA, OFWAT, local authorities and the water industry will give consideration to the following:

i. Finding ways of maximising the contribution to water savings by industry and agriculture (paras 2.19 and 7.12, pages 7 and 19).

ii. Improving the quality and quantity of data about abstraction and use of water (para 3.10, page 9).

iii. Improving demand forecasting methods (para 4.20, page 12).

iv. Initiating discussions with NRA, OFWAT and the water industry in order to seek general agreement on the criteria to be applied in assessing the economic case for household water metering and leakage control and a methodology for including environmental benefits (para 5.12, page 14).

v. Initiating trials of low volume dual-flush toilets, flushing valves and other toilets which save water (para 6.21, page 17).

vi. Including the installation of less than 6 litre flush toilets in new offices in the forthcoming revision by BRE of the new offices version of the BREEAM system (para 7.13, page 19).

vii. Provision of more thorough guidance for building and estate managers about the efficient use of water (para 7.15, page 19).

viii. Commissioning an assessment of the greater use of untreated water (para 8.11, page 21).

ix. Reviewing the role of Water Byelaws (para 9.13, page 23)

x. Controlling demand through:
   a. an incentive charging scheme for water abstractions (para 10.13, page 25), and
   b. making the licensing system more flexible (para 10.13, page 25).

xi Considering carefully the conclusions of the report on the social impact of water metering (para 11.20, page 29).

Measures on which views are particularly sought

12.4 The Departments welcome views on all the measures discussed in this paper, but particularly on the following:

i. Whether the promotion of efficient use of water should be furthered by:
   a. placing a positive duty on water companies (para 2.15, page 6),
   b. placing a parallel duty on the Director General (para 2.16, page 7),
   c. giving the Director General powers similar to those of the gas and electricity regulators (para 2.16, page 7).

ii. Whether water companies should be given mandatory targets for reducing leakage pending introduction of an incentive charging scheme for abstracting water (para 5.12, page 14).

iii. Whether using the sanctions available in Water Byelaws or reviving the practice of rewashering customers' taps without charge as a means of reducing waste are likely to be cost effective (para 5.14, page 14) or justified by environmental benefits and whether the powers of entry are satisfactory for these purposes (para 7.14, page 19).

iv. Whether it should be a requirement for all new houses to be provided with a shower and the extent to which showers should be encouraged in existing houses (para 6.11, page 16).

v. Whether the current maximum for toilet flush volumes and water usage in dishwashers and washing machines can be reduced now or in the near future and whether dual-flush toilets should be allowed to be installed in households after 1 January 1993 (para 6.20, page 17).

vi. Whether better design of hot water systems can best be achieved by regulation, education or a combination of both (para 6.22, page 17).

vii. Whether households using large volumes of water externally i.e. in swimming pools, ponds or the use of a hose, should have their supply metered (para 7.12, page 19).

viii. Whether it should be a Byelaw requirement that hoses should be actuated by a spring loaded trigger mechanism (para 7.12, page 19).

ix. Whether minimum urinal control systems should be made mandatory for existing properties together with periodic inspection of systems (para 7.13, page 19).

x. Whether Byelaw enforcement could be improved by a system of spot checks following publicity in an area about Byelaws and their enforcement (para 7.14, page 19).

xi. Whether NRA's powers to control where discharges take place should be strengthened, or whether firms should be provided with financial incentives to make discharges at the most desirable place (para 8.10, page 21).

xii. The most effective ways of promoting recycling and reuse of water in industry and commerce (para 8.13, page 21).

xiii. Whether Water Byelaws, replaced by national Regulations supplemented by Approved Documents, should be (para 9.13, page 23):

  a. integrated with the provisions of the Building Regulations covering waste water or retained as a separate code;

  b. enforced by water companies, local authorities or shared.

xiv. Whether measures to promote water metering should include (para 11.21, page 29):

  a. the inclusion of a wider range of factors, including the environmental benefits, when assessing the case for meter installation,

  b. a power for the Director General to approve decisions by water companies about charging methods,

  c. extension of the ban on the use of rateable values as a basis of charging to cover council tax valuations,

  d. development of more reliable techniques for remote meter reading and more co-operation between utilities in the field of meter reading.

Ongoing public education measures

12.5 An ongoing public information and education programme keeping the issues and developments in the public eye could have considerable long term effect. It is particularly important to get the message across to children of school age in order to safeguard the future. Some way of relating action to a target and monitoring progress would be particularly important to hold interest. This paper suggests a number of measures which can be taken by members of the public in order to save water. These measures might form the basis of ongoing public education. DOE and Welsh office will consider in conjunction with the water industry, how this guidance can best be provided. Views are invited on the measures and how they might best be promoted.

i. Keep water installations well maintained; rewasher dripping taps and repair or replace leaking pipes and water fittings (paras 5.14 and 7.14, pages 14 and 19).

ii. Consider the replacement of old inefficient toilets with modern low flush (6 litre) models (para 6.17, page 17).

iii. Reduce the flush capacity of existing toilets, but only where the efficiency of the flush is not impaired (para 6.17, page 17).

iv. Consider installing a simple shower but be careful not to use more water by more frequent and long use (para 6.18, page 17)

v. When purchasing washing machines and dishwashers look for those which use least water and have economy features (para 6.19, page 17).

vi. Only use washing machines and dishwashers when they are full, unless they have economy features, and whenever possible use them at night (para 6.19, page 17).

vii. Use water more efficiently:

  a. don't leave taps running unnecessarily,

  b. use a bowl in the sink,

  c. utilise the initial cold water drawn from the hot tap.

viii. Don't over water gardens; use a watering can rather than a hose; and water in the evening so as to reduce evaporation (para 7.3, page 18).

ix. Where possible use waste water from baths, sinks and appliances for garden watering (para 8.6, page 20).

x. Install a rainwater butt to collect water from roofs for garden watering (para 8.8, page 21).

12.6 Any guidance on water saving measures should include information about the relative amounts of water used for different purposes, and the most effective and least disruptive ways of economising.

APPENDIX I
STATUTORY PROVISIONS

Water Abstraction Licences

1. The licensing system in England and Wales covers both the abstraction of water from natural and artificial surface water courses, lakes, reservoirs and ponds and from underground aquifers, and also the impounding of water in artificial (or artificially enlarged) reservoirs. Although the policy and practical considerations about these two different activities can vary, the licensing system is the same for both. This Appendix does not refer separately to impounding.

2. In principle, and subject to certain exceptions, every abstraction of water from a watercourse, a body of water or an underground aquifer needs a licence. These licences are granted by the National Rivers Authority, who may, and regularly do, attach conditions to them. Their decisions are subject to an appeal to the Secretary of State for the Environment and the Secretary of State for Wales. The licensing provisions are now contained in Part 2 Chapter 2 of the Water Resources Act 1991.

History

3. The licensing system was introduced by the Water Resources Act 1963.

4. Before then, the rights of riparian owners to abstract water from surface watercourses and lakes were restricted only by the similar legal rights of other riparian owners (which, in brief, restricted abstraction to the normal and domestic farming uses of the riparian owner's land) or by local statutory provisions permitting abstraction for public or private water supply. There were no restrictions on abstraction from underground aquifers except in certain specially protected areas.

Licences of right and licences of entitlement

5. To meet the position of those who had been abstracting water regularly before 1963, the 1963 Act provided that those who had a statutory right to abstract water or who had actually been abstracting water at any time in the previous five years were to be entitled to a 'licence of right'.

6. Those with statutory rights to abstract would be given a licence to cover the amount, if any, specified in the statutory provision. Other abstractors and holders of statutory rights where the amount was not specified were to be given licences to cover the amount they had actually abstracted from time to time in the last five years.

7. The effect of this was to set the amounts of abstraction authorised by these licences of right at relatively high levels, since the levels to be specified were either statutory maxima intended to cover comfortably any likely abstractions or the highest levels that had been abstracted rather than the normal long-run level of abstractions.

8. Under provisions in the Water Act 1989, that are now contained in section 27 of the Water Resources Act 1991, the licensing system was extended to cover abstractions over 20 cubic metres per day for domestic or agricultural use on a riparian holding. Such abstractions had previously been exempt.

9. Those thus brought into the licensing system who had abstracted water at any time in the previous five years were given an entitlement to a licence to cover the amount that they had, from time to time, abstracted in that period. Such licences are conventionally referred to as 'licences of entitlement' to distinguish them from licences of right.

Exemptions from the need for licences

10. Licences are not needed for the following abstractions:

i. Protected rights to abstract

a. *abstractions of up to 20 m^3 (20,000 litres or about 4,400 gallons) a day from surface waters for domestic or agricultural uses (other than spray irrigation) on an adjoining riparian holding;*

b. *abstractions of up to 20 m^3 a day from underground aquifers for domestic uses;*

ii. Other abstractions

c. *abstractions by navigation, harbour, conservancy or land drainage authorities in the course of their functions;*

d. *occasional abstractions up to 5 m^3 (5,000 litres or about 1,100 gallons)*

e. *occasional abstractions up to 20 m^3 informally approved by the NRA;*

f. *abstractions for fire fighting;*

g. *abstractions linked to prospecting for water which have been approved by the NRA.*

Grants of new licences

11. The NRA, or (on appeal) the Secretary of State, may not grant a new licence which will interfere with abstractions under a protected right or abstractions under any existing licence (whether or not it is a licence of right or of entitlement). There are further restrictions to ensure that new licences do not adversely affect the water environment.

12. There can now be no new applications for licences of right or of entitlement: applications for the former had to be made within three months of the 1963 Act coming into force, and for the latter by 1 September 1990.

Modification and variation of licences

13. The NRA has power to modify or revoke a licence under Section 52 of the Water Resources Act 1991. The arrangements for modifying or revoking licences apply equally to all kinds of licences, whether they are licences of right, licences of entitlement or new licences granted on applications.

14. The initiative for modifying or revoking a licence may come from:

i. the holder;

ii. the NRA;

iii. the Secretary of State;

iv. the owner of any fishing rights in waters from which the licence permits any abstraction.

15. Section 61 of the Water Resources Act 1991 provides for compensation to be payable for any detrimental effects caused by the modification or revocation of the licence unless:

i. it is on the application of the holder;

ii. it is for failure to pay the abstraction licence charges; or

iii. no water has been abstracted under licence during the previous seven years.

Compensation

16. The compensation is due both in respect of any expenditure on work which is rendered abortive by the revocation or modification of the licence and in respect of any other loss or damage.

17. The compensation is payable by the NRA. Under the financial arrangements applying to the NRA the payment is to come from their Water Resources Account which is funded by the water abstraction licence charges. The charges are set under a scheme approved by the Secretary of State. If it were necessary, the scheme could be so structured that the effects of any particular payment of compensation were met by other licence-holders in the catchment area to which the compensation relates. The present scheme, and its proposed replacement in 1993, however, contain no such provision.

18. The basic approach in assessing compensation is that of compulsory purchase: in other words, where the effect of the modification or revocation is to deprive a particular piece of land of its supply of water, the compensation is likely to be the difference in the value of the land with and without the water.

River flows

19. NRA can also take action to alleviate water shortages by adjusting the flow of rivers like the Thames or major schemes for water transfer like the tunnel from the Ely Ouse to Essex.

20. In addition to their general duty under Section 19 of the Water Resources Act 1991 to conserve, redistribute or otherwise augment water resources and to secure their proper use, the NRA is also required by Section 15 of the 1991 Act to have particular regard to the statutory duties of water undertakers and sewerage undertakers. Section 16 of the 1991 Act enables it to exercise its powers in such a way as to further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographical features of special interest. It is carrying out studies in order to develop a strategy for water resources in England and Wales. But it mainly fulfils its water resources functions by exercising control over abstractions of water from surface or underground sources.

Maintenance of water supplies

21. Water companies have the statutory duty to maintain supplies under Section 37 of the Water Industry Act 1991 and will be judged on their ability to do so. Water companies have also recognised the importance of managing demand especially at times of shortage, and publicise the importance of using water properly and avoiding waste. To back up these appeals for voluntary cooperation, water companies can, when and where necessary, impose bans on the use of hosepipes for the watering of private gardens and the washing of private cars under Section 76 of the Water Industry Act 1991.

Water Byelaws

22. Water companies do, however, have some specific water saving functions through their responsibility for administering the Water Byelaws in their areas. The purpose of the Byelaws is to prevent waste, undue consumption, misuse or contamination of water supplied by a water undertaker, which has a power to make, and a duty to enforce them, under Section 17 of the Water Act 1945. All water undertakers in Great Britain have Byelaws, based on Model Byelaws drawn up by DOE in conjunction with the water industry and published in 1986[15]. The UK Water Fittings Byelaws Scheme (operated by the water industry, manufacturers and installers) makes provision for the assessment and testing of water fittings to ascertain whether they comply with Byelaws. The Scheme is serviced by the Evaluation and Advisory Testing Centre of WRc plc.

23. Under Section 73 of the Water Industry Act 1991 it is an offence if the owner or occupier of any premises intentionally or negligently causes or suffers a water fitting to be or remain so out of order, so in need of repair, or so constructed or adapted, or to be so used, that various specified effects occur, including the waste or likely waste of water or (having regard to the purpose for which it is supplied) the misuse or undue consumption of water. Anyone

found guilty of this offence is liable to a fine not exceeding level 3 on the standard scale. There are also powers in Section 75 of the 1991 Act for a water company to take action to prevent damage or waste.

Drought orders

24. Where measures are not enough to deal with the effects of drought, a water company can apply to the Department of the Environment or Welsh Office for a drought order under Section 73 of the Water Resources Act 1991. Drought orders are made for up to a six-month period and can authorise:

- i. further restrictions by a water company on non-essential uses of water such as watering gardens by hosepipe or filling swimming pools or ornamental ponds, in order to conserve supplies for more important uses;
- ii. abstraction of more water from a surface or underground source than would otherwise be allowed;
- iii. temporary use of water sources from which abstraction has not been licensed; or
- iv. reductions in the amount of water that would otherwise have been released from a reservoir to maintain a river flow.

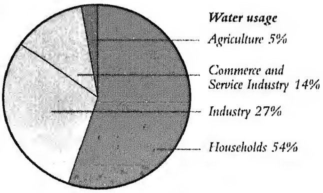
25. NRA advise on the potential effect of such applications on water resources, the environment and people licensed to abstract water. If there are valid objections when a proposal for a drought order is advertised, there must normally be a public local inquiry or hearing by an inspector appointed by the Secretary of State. If there were to be a more severe shortage of water than is expected this summer, the Secretary of State could authorise the water company or companies affected to make rota cuts or provide emergency supplies.

APPENDIX 2
COMPONENTS OF WATER DEMAND

Use by category of consumer

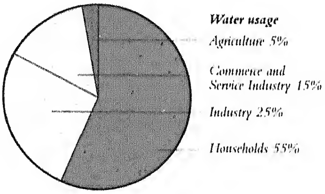
1. The volume of water supplied for household, commerce and service industry, agricultural and industrial use can be influenced by several factors and may therefore change to varying degrees from year to year. For example, a dry summer may increase the amount used for agriculture; high economic growth will increase the demand from industry, commerce and the service sector; during periods of recession with increased unemployment more water will be used in households.

2. A 1981 analysis of public water supply in England and Wales, excluding leakage, by category of consumer[16] suggests the following breakdown:



(<1% miscellaneous use has been disregarded)

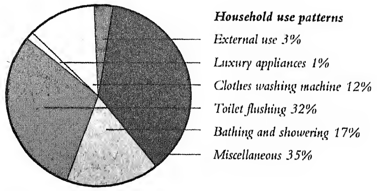
3. A different, arguably simplistic, approach would be to take the Water Services Association (WSA) estimate of current average domestic consumption per capita as the starting point[17]. In 1990 that was estimated at about 140 litres per person per day. WSA also estimated that 50.878 million people are supplied with water by water companies. That would indicate a total consumption by households in England and Wales of about 7,150 megalitres per day (Ml/d). If water put into the public supply in 1990 was about 17,300 Ml/d and assuming 25% of that is lost through leakage or is otherwise unaccounted for, that would imply a total of about 5,850 Ml/d for commercial, industrial and agricultural customers. Assuming a shift in the relative proportions from industry to household, commerce and service industry between 1981 and 1990 the following is suggested as an estimate of the proportions of water supplied by category of consumer in 1990:



Components of water use

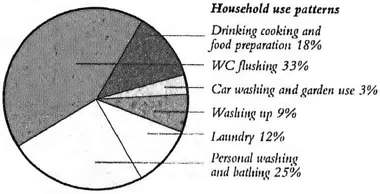
4. Several studies of the components of household use have been undertaken by individual water companies. Details of studies carried out in three water company areas around 1977 were published in a National Water Council Occasional Technical Paper in 1982[18]. Data from the former Severn Trent and South Western Water Authorities and data in the IWES *Water Practice Manual*[16] together

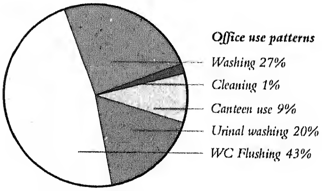
with data from *Waterfacts* published in 1991[17] all provide similar proportional breakdowns between the main elements of usage. This suggests there has been few more recent studies. Major uses are as follows:



Source: 'Waterfacts' 1991

5. Further information about use is contained in a 1978 research report from the Building Research Establishment[9]. The breakdown of components differs somewhat, but office usage is also given. These patterns of use are shown below.





Source: BRE Current Paper CP65/78

6. Utilising this data and making the following assumptions it is possible to construct a table showing the current broad estimated volumes and relative proportions of water supplied to each category of user broken down into the main components of use. Assumptions for household use are:

i. an increase in domestic appliance ownership. A small increase in water used for personal hygiene. A small reduction in the proportion used for flushing toilets due to the installation of lower flush toilets.

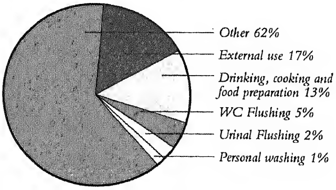
Assumptions made for commerce and service industry use are:

ii. assumed greater impact in volume of water used because of reduced flush cisterns, partly offset by more people at work in commerce. Small increase in drinking, cooking and food preparation as a result of modern appliances.

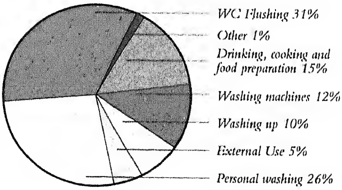
Although information is available about the amounts of water used in different industries, no information has been found about the components of use in industrial premises. It has been assumed that the bulk of water supplied is likely to be used in manufacturing processes.

The estimated amounts of water used by each sector are shown in the pie charts below (and brought together in the bar chart at the end of para 3.8, page 8).

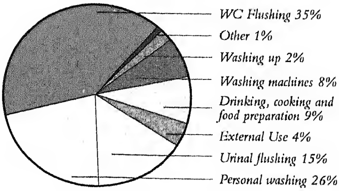
INDUSTRY AND AGRICULTURE
Total 3900 Ml/day (30%)



HOUSEHOLD
Total 7150 Ml/day (55%)



COMMERCE AND SERVICE INDUSTRY
Total 1950 Ml/day (15%)



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